Studies in techniques for image and video security

Abstract

The focus of this research work is to study, analyze and develop robust techniques for information hiding, image/video encryption techniques and to design an efficient conditional access based system.

First we develop an improved lossless data hiding scheme for digital images using Integer Wavelet Transform (IWT) and threshold embedding technique. Data are embedded into the least two significant bit-planes of high frequency Cohen-Daubechies-Feauveau (CDF) (2,2) integer wavelet coefficients, whose magnitudes are smaller than a certain predefined threshold. Histogram modification is applied as a preprocessing to prevent overflow/underflow. Experimental results show that this scheme performs better than prior techniques in terms of a higher payload and better image quality.

Next we show that a generic watermark removal attack on a correlation-based watermarking scheme can be extended in general to a forgery attack on the same. In certain cases, even if there exists a weak watermark removal strategy, it may be extended to a strong forgery attack. We prove our case by implementing our strategy against Modified Differential Energy Watermarking (MDEW) which is considered to be one of the robust correlation-based watermarking schemes in the DCT domain, proposed by Das, Maitra and Mitra in IEEE Transactions on Signal Processing, 2005.

Then we also develop a Conditional Access based System (CAS) for ‘Image On Demand (IOD)’ commercial applications, using index locations of the DCT coefficients. Here we point out the significance of using the index locations of the DCT coefficients as a unique descriptor of any image and propose a novel scheme that can be efficiently adapted for any CAS. The DCT coefficients are sorted by magnitude generating two data sets (a) sorted DCT coefficients and (b) An array which contains their original index locations. We show that the distribution of values (DCT Index locations) in the generated array is significantly different for various images, and we exploit this to design an efficient CAS based scheme. Thus, the index locations play a significant role in representing an image whereas the actual values of the DCT coefficients have lesser effect. We propose a scheme in which we share a low quality version of an image with the customers. We keep secret an optimal number of index locations which are the most significant. These, we share to the customers only on demand, to construct the corresponding high quality image.

Finally we carry out a research work around JPEG and MPEG encryption. Through this research we propose a new format preserving selective encryption scheme for JPEG/MPEG which is compression friendly as well as highly secure. We choose quantized DCT coefficients of the I-frame for encryption. The resultant image/video is completely obscure and is suitable mainly for high end security applications.

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